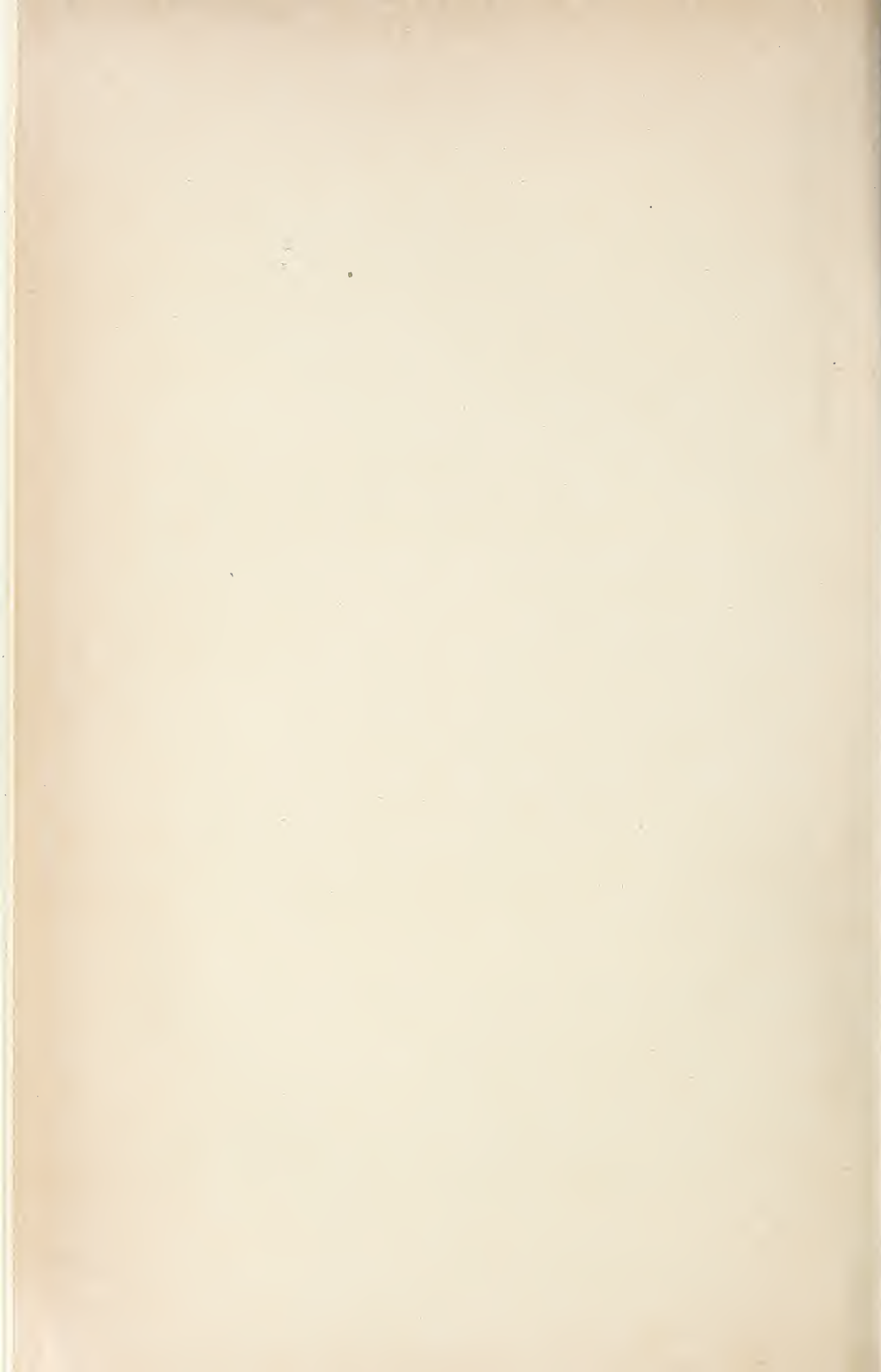
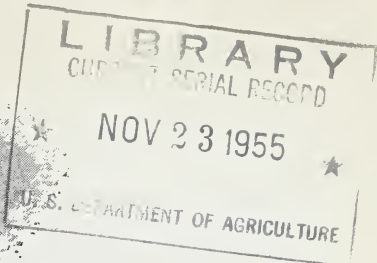


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*An Improved Moting System for*

# COTTON GINS

By Charles M. Merkel  
Vernon P. Moore

*Circular No. 974.*

UNITED STATES DEPARTMENT OF AGRICULTURE

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# *An Improved Moting System for* **COTTON GINS<sup>1</sup>**

By CHARLES M. MERKEL, *agricultural engineer*, and VERNON P. MOORE, *cotton technologist, Agricultural Engineering Research Branch, Agricultural Research Service*

## **NEED FOR AN IMPROVED MOTING SYSTEM IN GINS**

The limits to which cotton may be cleaned at the gin with existing types of equipment have been established by laboratory tests. These tests also showed that the removal of additional foreign matter is desirable on the trashier cottons to obtain maximum potential grade benefits. Since exceeding the established limits of seed-cotton cleaning equipment in the gin usually results in fiber damage, with only slight grade improvement but with excessive outlays of capital by the ginner, it was deemed advisable to make an effort to improve the effectiveness of the various machines to obtain more cleaning without causing fiber damage.<sup>2</sup>

Part of the foreign matter that enters the roll box of the gin stand with the cotton is mixed with the fibers during the ginning process and is carried by the saw teeth with the small groups of fibers through the gin ribs for doffing. At no place in the ginning system are the fibers more thinly distributed or held more firmly in a position for cleaning than on the saws during this stage in the ginning process. Existing moting systems did not take full advantage of the natural forces acting on the small tufts of fiber to remove fine particles of foreign matter and immature seed and motes. It was in an effort to utilize these forces that improvements in the moting system were undertaken.

## **PRINCIPLES AND METHODS EMPLOYED IN MOTING SYSTEMS**

Trash removal from the fibers held by the gin saw was accomplished by natural forces apparent in even the very early model gin stands. This action was commonly referred to as moting, since a large part of the foreign matter removed was motes, which are immature seed

<sup>1</sup> Based on cooperative work conducted by the former Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Service, and the former Cotton Division, Production and Marketing Administration.

<sup>2</sup> MOORE, V. P., and MERKEL, C. M. CLEANING COTTON AT GINS AND METHODS FOR IMPROVEMENT. U. S. Dept. Agr. Cir. 922, 50 pp., illus. 1953.



with short, immature fibers attached. Early model gins used brushes for doffing fiber from the saws. These early designs of brush gins provided for removal of trash below or after the point of doffing, where the motes and other foreign matter were thrown downward. This moting system was referred to as a gravity type (fig. 1). Actually

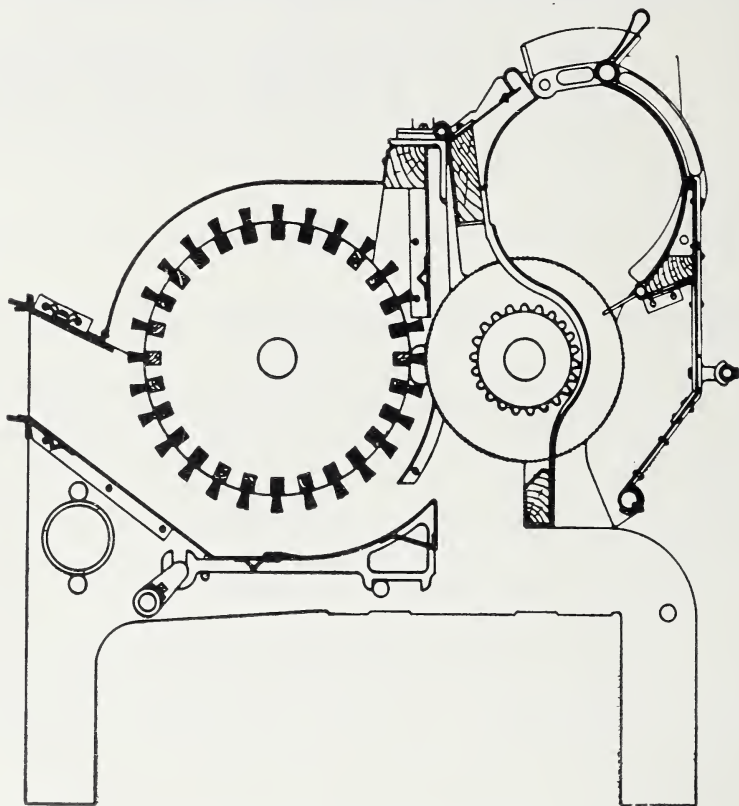


FIGURE 1.—Gravity-moting brush gin.

several actions combined to effect the removal of the foreign matter at this point. These forces that acted on the fiber as well as the foreign matter were dependent on the differences in weight or mass for separation. Centrifugal force, velocity, and gravity all played a part in the effectiveness of this system of moting, which was later used in an air-blast doffing gin that discharged the motes below the doffing point (fig. 2). The efficiency of the so-called gravity moting system was limited by the extent to which the various forces could be effectively applied by the mechanical designs, which were further restricted by lack of space.

Optimum designs for ribs, roll box, and seed-discharge passage were first worked out for maximum capacity consistent with smooth ginning, as the primary function of the gin is to separate the fiber from the seed. About one-half of the circumference of the gin saw was required for accomplishing the fiber and seed separation. In

the early designs of brush doffing gins, about one-fourth the circumference was required for the doffing system. This left only about one-fourth of the circumference, or about 9 inches of space, in which to accomplish cleaning and disposing of the foreign matter that was removed.

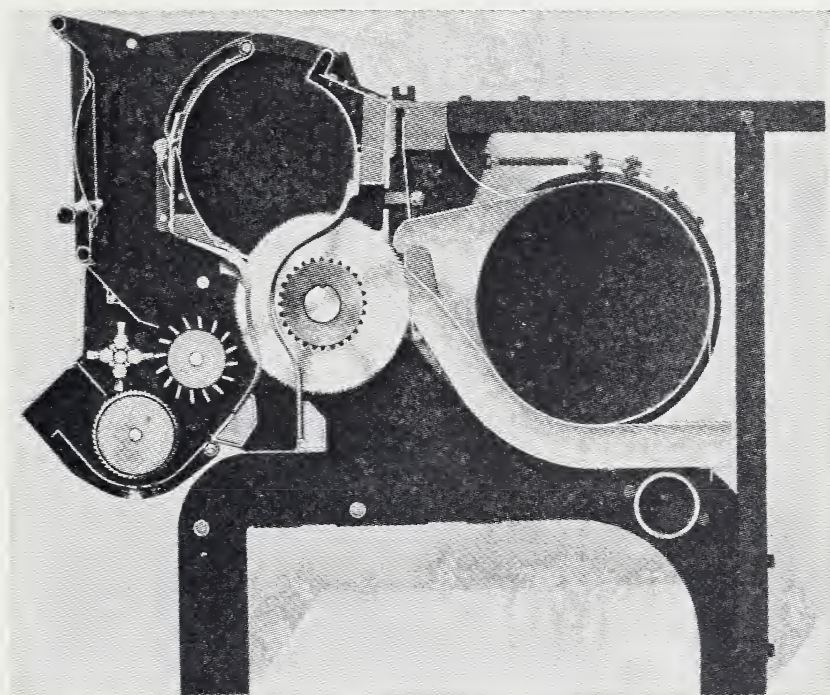


FIGURE 2.—Gravity-moting air-blast gin.

Different manufacturers of cotton gins and individual inventors have added a large number of patents to the list of cotton ginning inventions in their efforts to use the spaces behind the gin saws and ribs for better moting and cleaning. Eleazor Carver's inventions, with those of Lumpkin, Phelps, and Fordyce, established principles of underneath and overhead moting between the time when the fiber-carrying teeth left the gin ribs and returned to the lower part of the ginning ribs (fig. 3). About 1938 the cotton ginning manufacturers in the United States began a series of improvements that ranged from double-moting to air-wash methods of various types.

Limitations in the effectiveness of the gravity and overhead moting systems caused designers to make numerous attempts to improve the action of these fiber-cleaning systems. Much of the trash thrown off by centrifugal force in the overhead moting system was pulled back into the lint stream by the siphoning action of air induced by the high-velocity air-blast jet. A large part of this induced air was pulled directly over the air-blast nozzle and from the chamber into which the foreign moting material had been thrown. Further difficulties with overhead moting systems were encountered with accumulations of sticky, honeydew-laden material on the top of the nozzle.

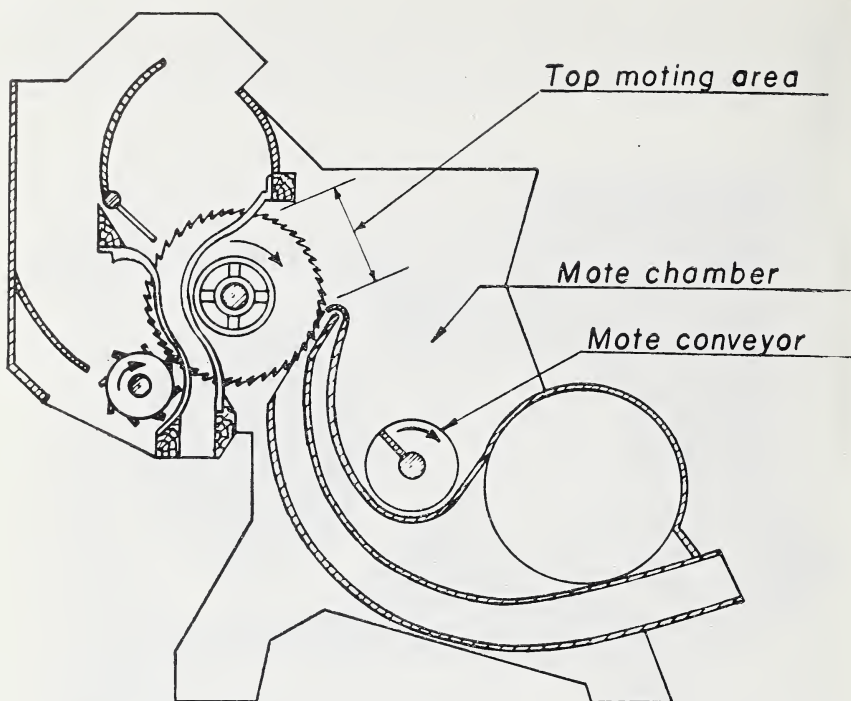


FIGURE 3.—Cross section of a centrifugal, or overhead moting, gin.

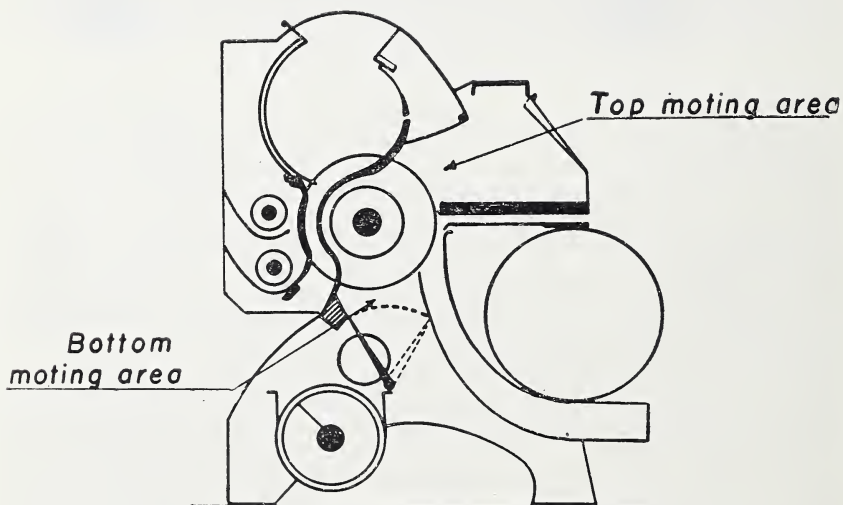


FIGURE 4.—Cross section of a double moting gin.



Weaknesses in gravity moting systems in brush gins resulted from unsolved design problems connected with controlling the pressures within the lint flue duct and with mote-board settings that would provide for trash discharge without lint loss. The success of this moting system was largely dependent upon accelerating the lint and trash to a velocity at which the trash and motes could be thrown through the air stream induced by the brush that was employed to turn the lint into the lint duct. As with the overhead system, much of the trash that had been discharged and thrown out was in turn pulled back into the lint stream. To overcome this, "splitters" and other deflecting devices were used.

Gravity-moting air-blast gins employing double-break nozzles with adjustable mote boards at the entering end of the lint duct were used with some success up until about 1937. At this time provisions were made to allow for trash discharge above the nozzle by centrifugal force and below by gravity plus centrifugal force in a so-called double moting gin (fig. 4). Gins of this type have been improved to a marked degree since that time and are still being manufactured. Improvements in overhead moting gins have been made by commercial gin-machinery manufacturers in recent years. These improvements have provided for keeping the tops of the nozzle clean and have included suction and vacuum chambers to prevent siphoning of foreign material back into the lint stream. Some of the late designs have incorporated a stationary grid bar so located that additional trash might be scutched from the fiber held on the saw teeth.

Recognizing the fact that full advantage was not being made of the natural forces acting on the cotton in a gin, research to aid in cleaning the lint was initiated at the Stoneville (Miss.) Laboratory in 1949 by exploring the possibility of devising practical improvements for existing systems. This work led to the development of the reciprocleaner, which was subjected to laboratory and field tests during the 1953 fiscal year.<sup>3</sup>

## DEVELOPMENT OF THE RECIPROCLEANER FOR IMPROVING THE MOTING ACTION OF GIN STANDS

### CONSTRUCTION OF 3-BAR RECIPROCLEANER

The first model to be constructed consisted of 3 stationary grid bars located above the gin air-blast nozzle and located  $\frac{3}{16}$ -inch from the saw cylinder. The purpose of grids was to impart threshing and combing actions to the lint to aid in the removal of fine pin-and-pepper trash while the lint was held firmly by the saw teeth. The edges of the grid bars coming in contact with the lint were notched to accentuate the combing action. The unit was installed in a 1945 model gin stand that did not then contain any of the improvements in moting action that came into stands 3 or 4 years later. Trial runs of this model did not prove to be satisfactory, although close observation of the unit showed that very good cleaning action was being obtained from the use of the bars. Foreign matter and lint were built up between the saws and on the grid bars, choking the stand,

<sup>3</sup> Charles A. Bennett and Thomas E. Wright are co-inventors of the cotton gin cleaner (U. S. Patent No. 2,634,461, issued April 14, 1953).

and too much foreign matter was pulled back by the siphoning action of the air blast. Curved ducts leading from the trailing edge of the grids were installed in an attempt to prevent that action (fig. 5). The amount of foreign matter drawn back into the lint stream was reduced to some extent, but it was obvious that a better arrangement was required if the full cleaning potential was to be achieved.

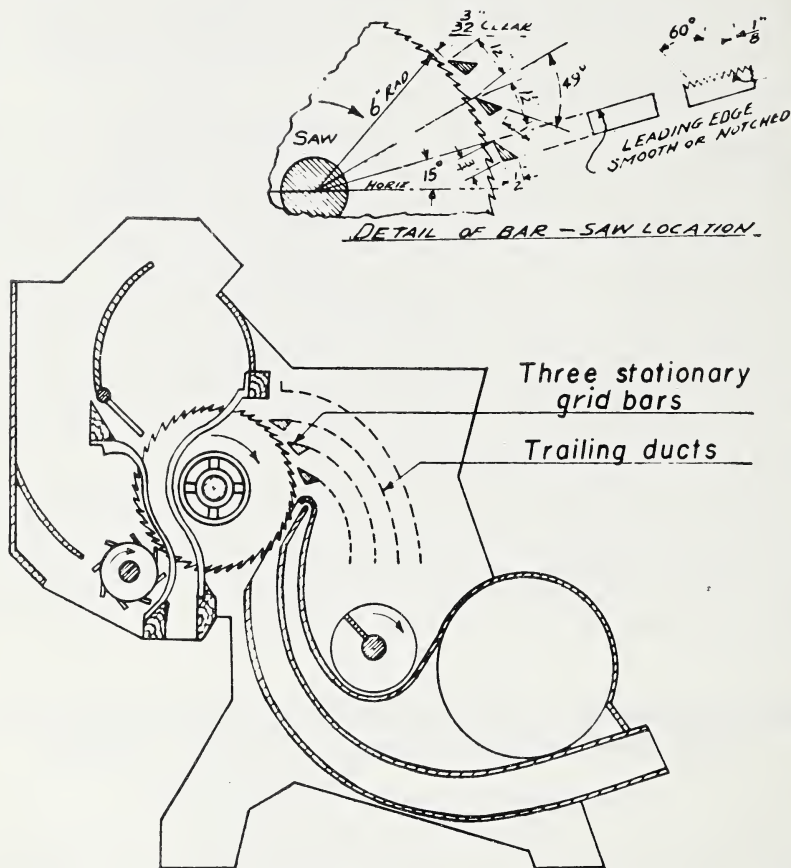


FIGURE 5.—Cross section of a gin stand, showing the location of the grid bars and trailing ducts and detail of the notched grid bars.

The system was redesigned to make the bars movable in order to avoid any buildup of foreign material between the saws, and the trailing ducts were sealed at the lower end with a vacuum roller (fig. 6). The bars moved back and forth, or reciprocated, parallel to the saw cylinder at a rate of approximately 50 cycles per minute. The foreign matter feeding from the grids into the dead-air chamber was in turn fed into the trash chamber by the vacuum roller. Trial tests showed that the bars were kept clean by the reciprocating action and that the induced air currents entering the system from above the air-blast nozzle had been practically eliminated. Tests of this model run with and without the vacuum roller appeared to be promising. The re-

ciprocleaner operating with a vacuum wheel removed an average of 11.7 pounds of foreign matter per bale as compared with 9.9 pounds without the vacuum wheel (table 1). Grade improvement with the vacuum wheel was very slight, only 0.3 of a code point, but the tests

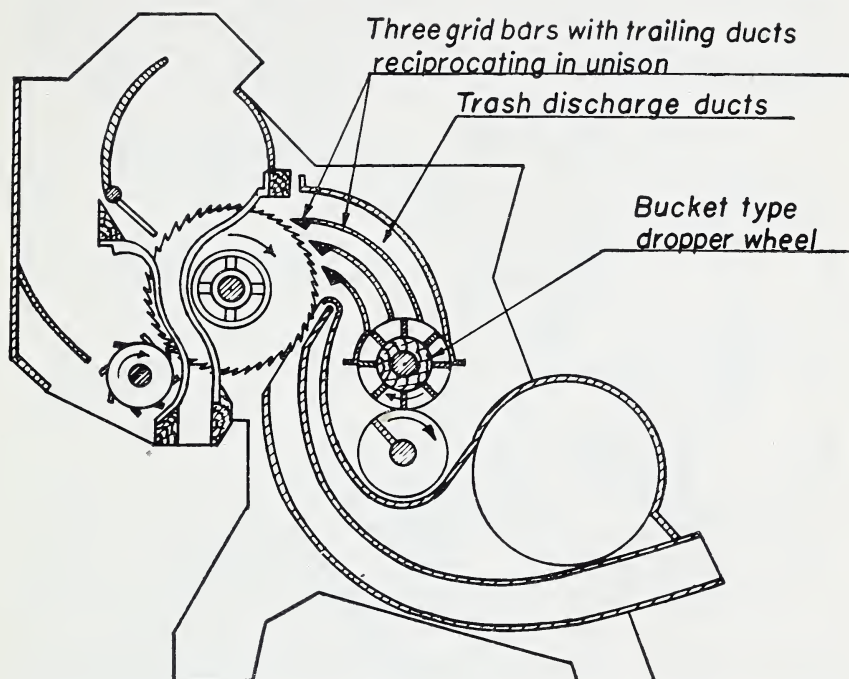


FIGURE 6.—Cross section of a gin stand, showing the 3-bar reciproc cleaner and the dropper-wheel seal on the trailing edge of the trash-discharge ducts.

TABLE 1.—Effect of using a vacuum wheel in connection with reciproc cleaner grid bars on the removal of foreign matter from lint cotton<sup>1</sup>

Item	Grid bars—	
	Without a vacuum wheel	With a vacuum wheel
Foreign matter removed.....pounds per bale..	9. 9	11. 7
Classification data:		
Grade index.....	87. 1	87. 4
Grade designation.....	LM+	LM+
Staple length..... $\frac{1}{32}$ -inch..	34. 7	34. 8
Fiber data:		
Upper half mean length.....inches..	1. 08	1. 09
Uniformity ratio.....	75	77

<sup>1</sup> Average of 10 replications on 2 machine-picked cottons.

did show that the vacuum wheel was justified and the reciproc-cleaner had no adverse effect on the fiber length as determined by the classer and by fiber tests.

Throughout the test runs, tags of lint cotton built up on the reciproc-cleaner bars, making frequent stops of machinery necessary for tag removals. In an effort to overcome this condition, the notched grid bars were replaced by smooth curved ducts, the leading edges of which served as grid bars (fig. 7). This was accomplished by making the

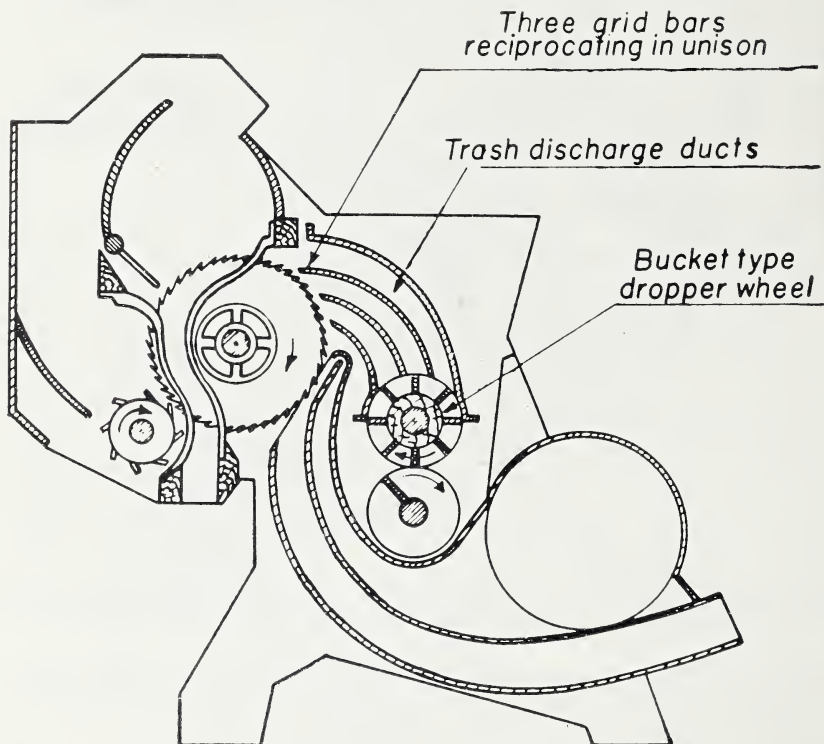


FIGURE 7.—Cross section of a gin stand equipped with a 3-bar reciproc-cleaner, showing the grid bars and ducts formed from single sheets of heavy metal.

trash ducts of heavier gage material. Trial runs showed that the smooth grids allowed continuous operation because lint did not build up on them. Tests carried out in 10 replications on each of the 2 machine-picked cottons showed that the smooth bars removed about twice as much material per bale as did the saw-tooth bars, but there were no additional grade improvements, owing to the extra weight removals (table 2). Throughout these tests the device operated rather satisfactorily, but there was a tendency for trash to build up in the trash-discharge ducts leading from the grid bars. In an effort to prevent this, a model was constructed in which the mote trash was removed by suction rather than by gravity, as had been the case in previous models (fig. 8).



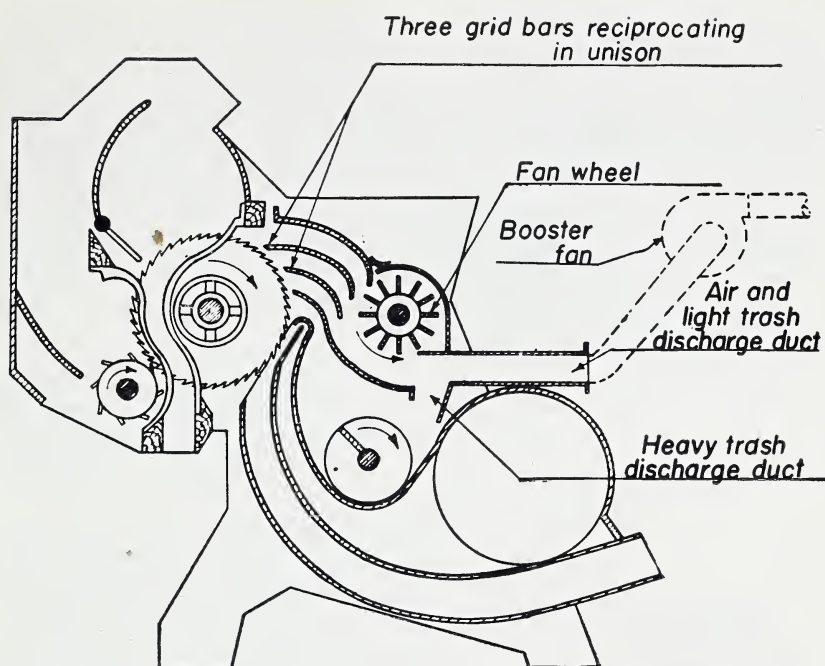


FIGURE 8.—Cross section of a gin stand equipped with a 3-bar reciprocator and a suction trash-discharge duct.

TABLE 2.—Comparative effectiveness of saw-tooth and smooth surface reciprocator grid bars on the removal of foreign matter from lint cotton <sup>1</sup>

Item	Saw-tooth grid bars	Smooth grid bars
Foreign matter removed..... pounds per bale..	8. 25	16. 80
Classification data:		
Grade index.....	88. 3	86. 7
Grade designation.....	LM +	LM +
Staple length..... $\frac{1}{32}$ -inch..	34. 6	34. 9
Fiber data:		
Upper half mean length..... inches..	1. 09	1. 06
Uniformity ratio.....	76	80

<sup>1</sup> Average of 10 replications on 2 machine-picked cottons.

### EVALUATION OF 3-BAR RECIPROCLEANER

After preliminary tests, a comprehensive series of tests was carried out to compare the 2 reciprocators with a 1945 model standard gin. In the test that was carried out in 3 replications on midseason machine-picked cotton, the 2 models were operated with and without lint cleaning, as was the standard gin (table 3). The seed cotton used for the tests averaged 15.5 and 7.8 percent in moisture content and

foreign matter, respectively. A standard gin without lint cleaning gave an average grade index of 98.8, or Middling minus, as compared with 99.5, or Middling, with the reciprocleaner using a gravity-mote discharge. In these tests the reciprocleaner with the suction-mote discharge gave no grade improvement over the standard gin, although Shirley Analyzer tests showed that it removed as much foreign matter from the lint as did the gravity-discharge model. On a weight basis,

TABLE 3.—*Moisture and foreign-matter content of machine-picked cotton prior to ginning and the comparative effects of standard and reciprocleaner gin stands, with and without lint cleaners, on lint moisture and foreign-matter content and removal, classification, fiber and spinning quality elements*<sup>1</sup>

Evaluation item	Standard gin		3-bar reciprocleaner with gravity-mote-and-trash discharge		3-bar reciprocleaner with suction-mote-and-trash discharge	
	Without lint cleaner	With lint cleaner	Without lint cleaner	With lint cleaner	Without lint cleaner	With lint cleaner
Moisture content:						
Wagon sample.....percent	15.5	15.5	15.5	15.5	15.5	15.5
Lint sample.....do	7.2	6.3	8.2	7.7	7.8	7.6
Foreign-matter content:						
Wagon sample.....do	7.8	7.8	7.8	7.8	7.8	7.8
Feeder sample.....do	1.7	1.8	1.9	2.0	2.2	1.9
Lint sample <sup>2</sup> .....do	3.9	3.5	4.4	3.5	4.4	3.4
Classification data: <sup>3</sup>						
Grade index.....	98.8	100.0	99.5	100.0	97.7	99.7
Grade designation.....	M—	M	M	M	M—	M
Staple length..... $\frac{1}{32}$ -inch	34.5	34.5	34.3	34.5	34.5	34.5
Foreign matter removed: <sup>4</sup>						
Moting system.....pounds	2.8	2.8	5.7	5.7	6.4	6.4
Lint cleaner.....do		4.1		3.8		3.9
Fiber data:						
Upper half mean.....inches	1.00	.99	1.01	1.01	1.01	.99
Uniformity ratio.....	75	76	74	75	76	75
Tensile strength						
1,000 pounds per square inch	73	76	76	75	73	72
Spinning data: <sup>5</sup>						
Picker and card waste.....percent	10.4	9.2	9.8	10.3	9.4	9.0
Neps per 100 square inches of web						
number	27	34	27	25	31	32
Yarn skein strength—						
22s.....pounds	98	96	98	98	100	97
50s.....do	34	33	34	33	34	33
Yarn appearance—						
22s.....index	110	110	110	120	110	110
50s.....do	100	100	90	100	100	90
Average of all counts spun	105	105	100	110	105	100

<sup>1</sup> Average of 3 replications on midseason cotton.

<sup>2</sup> As determined by Shirley Analyzer tests.

<sup>3</sup> Average of 2 classifications on each replication.

<sup>4</sup> Based on 1,500 pounds of seed cotton.

<sup>5</sup> Replicate lots processed separately through the card and combined for spinning.

the suction moting system removed 6.4 pounds of material per bale as compared with 5.7 pounds from the gravity moting model and 2.8 pounds from the standard gin. As reflected by the grades, the reciprocleaner removed almost as much material from the lint as the lint cleaner in each case. Fiber and spinning tests indicated no adverse effects resulting from either model of the reciprocleaner. There was no significant increase in nep count or decrease in yarn strength or appearance. Suction moting, however, was abandoned because of the excessive lint loss without any increase in grade over that obtained with a gravity moting system.

#### SPECIAL GIN RIB FOR USE WITH RECIPROCLEANER

A special gin rib was designed for use with the reciprocleaner on the premise that additional combing action of the rib should increase the cleaning action of the unit (fig. 9). Tests carried out in 3 replications on both hand- and machine-picked cotton showed, however, that no additional grade improvement or cleaning action could be attributed

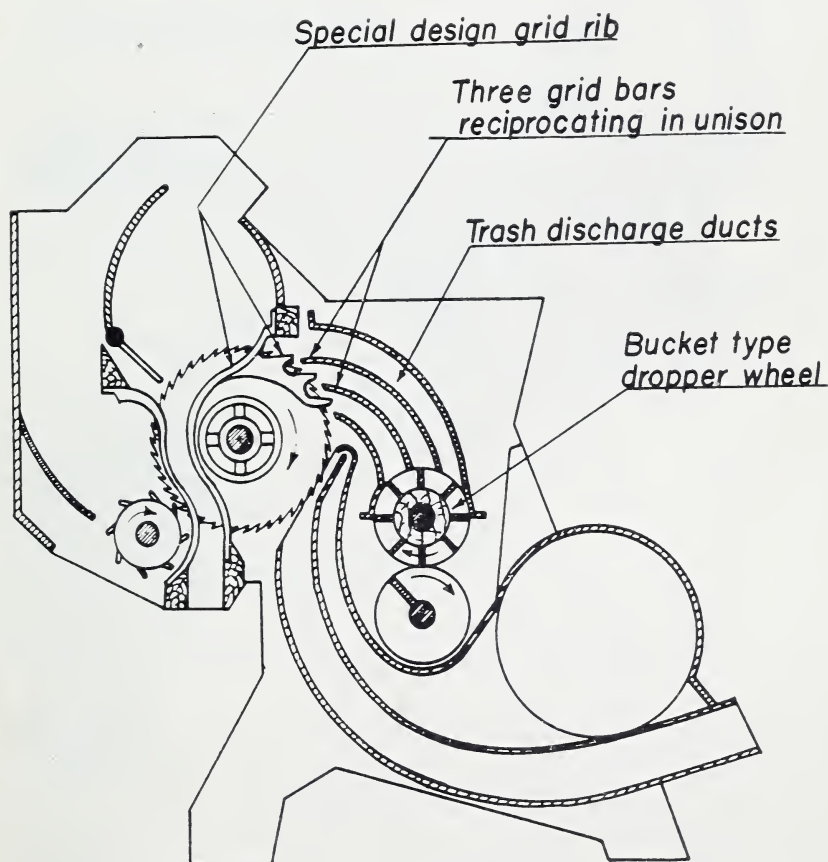


FIGURE 9.—Cross section of a gin stand equipped with a 3-bar reciprocleaner and gin rib designed to impart a combing action to the cotton while it is still held by the gin saw.

to the special rib. It was, therefore, abandoned, even though spinning tests indicated that it had no adverse effect on spinning quality.

#### CONSTRUCTION OF 2-BAR RECIPROCLEANER

Up to this time, models of the reciprocleaner were equipped with 3 moting bars for combing the fiber. Throughout the various tests it was noted that foreign matter collected on the third bar and in continuous operation would cause a chokeage. Failures to eliminate this condition led to the construction of a model containing only 2 bars, to ascertain whether a like amount of cleaning could be accomplished with 2 bars and also to eliminate the tendency of the device to choke (figs. 10 and 11). Trial runs appeared to be promising. Tests made

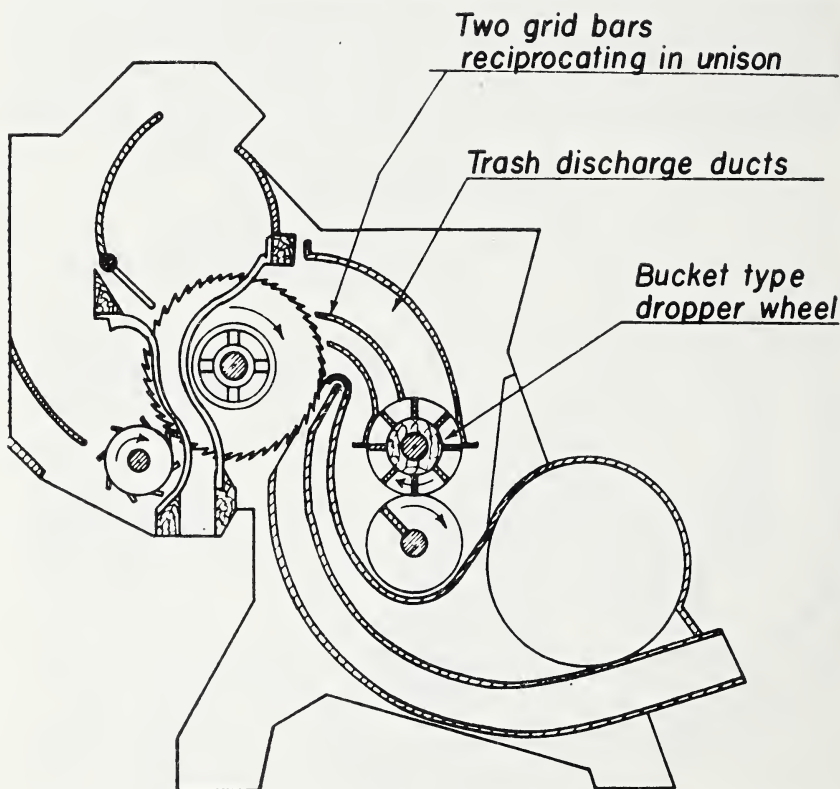


FIGURE 10.—Cross section of a gin stand equipped with a 2-bar reciprocleaner.

in 10 replications on late-season machine-picked cotton showed that the 2-bar unit was as effective as the 3-bar unit from the standpoint of grade improvement (table 4). There was a total of 15.7 pounds of foreign matter per bale removed from the lint by the 2-bar reciprocleaner unit as compared with a total of 20 pounds removed by a standard gin and lint cleaner combined. The 2-bar unit removed 3 pounds per bale more material from the lint than did the 3-bar unit. Fiber tests did not indicate that the 2-bar unit had any adverse effects on fiber quality.



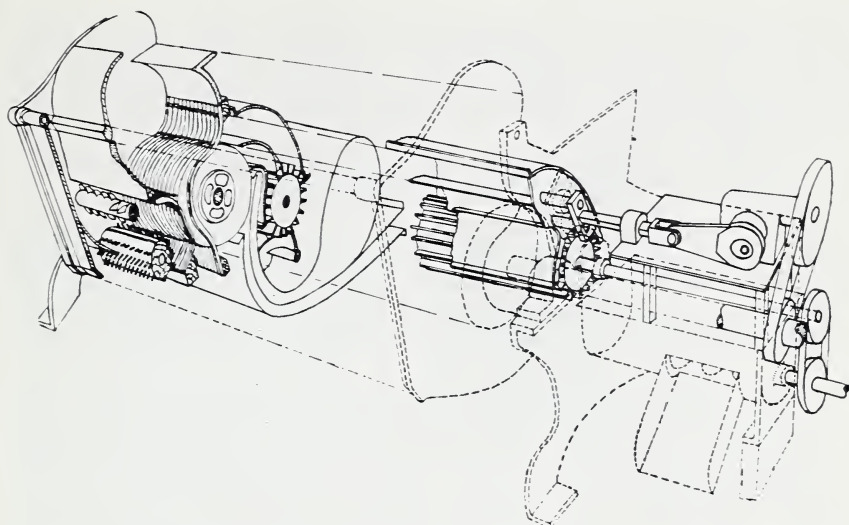


FIGURE 11.—An isometric view of a gin stand equipped with a 2-bar reciprocator and showing the drive mechanism.

TABLE 4.—*Moisture and foreign-matter content of machine-picked cotton prior to ginning and the comparative effects of a standard gin stand, with and without lint cleaner, and 3-bar unit and 2-bar unit reciprocator gin stands on lint moisture content, classification, foreign-matter content and removal, and fiber quality elements*<sup>1</sup>

Item	Standard gin		Reciprocator	
	Without lint cleaner	With lint cleaner	3-bar unit	2-bar unit
Moisture content:				
Wagon sample..... percent ..	10.0	10.0	10.0	10.0
Lint sample..... do ..	6.6	6.3	6.3	6.8
Foreign-matter content:				
Wagon sample..... do ..	7.8	7.8	7.8	7.8
Feeder sample..... do ..	3.6	3.6	3.4	3.2
Classification data: <sup>2</sup>				
Grade index.....	83.5	85.9	84.3	84.2
Grade designation.....	LM	LM	LM	LM
Staple length..... $\frac{1}{32}$ -inch ..	34.3	34.3	34.2	34.2
Foreign matter removed: <sup>3</sup>				
Mote trash..... pounds ..	8.5	8.5	12.7	15.7
Lint cleaner trash..... do ..		11.5		
Fiber data:				
Upper half mean..... inches ..	1.05	1.04	1.04	1.05
Uniformity ratio.....	75	74	74	74
Tensile strength..... 1,000 pounds per square inch ..	73	72	73	73
Fineness..... micrograms per inch ..	3.9	3.9	3.9	3.9

<sup>1</sup> Average of 10 replications on late-season cotton. No overhead cleaning used.

<sup>2</sup> Average of 4 classifications.

<sup>3</sup> Based on 1,500 pounds seed cotton.

The reciprocleaner is an integral part of the gin stand and cannot be bypassed like a separate lint cleaner. Therefore, reciprocleaner tests were made, with and without a lint cleaner, on both hand- and machine-picked cottons, which were representative of an entire season.

### COMPARISON OF THE 2- AND THE 3-BAR RECIPROCLEANERS WITH A STANDARD-GIN MOTING SYSTEM

In the hand-picked cotton the moisture content averaged 6.5 percent in seed cotton with slightly more than 4 percent in the lint, which is relatively dry (table 5). The cotton was very clean when harvested, containing only 2.3 percent of foreign matter. This clean-picked cotton showed no grade benefits when using either the 2- or 3-bar recipro-

TABLE 5.—*Moisture and foreign-matter content of hand-picked cotton prior to ginning and the comparative effects of a standard gin and 3- and 2-bar reciprocleaner units, with and without lint cleaners, on lint moisture, foreign-matter content and removal, classification, and fiber quality elements*<sup>1</sup>

Item	Standard gin		Reciprocleaner			
			3-bar unit		2-bar unit	
	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing
Moisture content:						
Wagon sample.....percent...	6.5	6.5	6.5	6.5	6.5	6.5
Lint sample.....do.....	4.5	4.4	4.2	4.2	4.3	4.2
Foreign-matter content:						
Wagon sample.....percent...	2.3	2.3	2.3	2.3	2.3	2.3
Lint sample <sup>2</sup> .....do.....	3.2	2.7	3.1	2.9	3.0	2.8
Classification data: <sup>3</sup>						
Grade index.....	103.0	103.9	103.0	103.6	103.2	103.5
Grade designation.....	SM—	SM	SM—	SM—	SM—	SM—
Staple length..... $\frac{1}{32}$ -inch...	33.6	33.9	33.4	33.6	33.5	33.9
Foreign matter removed: <sup>4</sup>						
Moting system—						
Motes.....pounds.....	1.3	1.3	2.9	2.9	3.3	3.3
Leaf trash.....do.....	.6	.6	1.4	1.4	1.5	1.5
Lint.....do.....	.3	.3	.9	.9	1.3	1.3
Total.....do.....	2.2	2.2	5.2	5.2	6.1	6.1
Lint cleaner.....do.....		4.8		4.9		4.7
Fiber data:						
Upper half mean length inches.....	1.02	1.02	1.01	1.01	1.01	1.01
Uniformity ratio.....	76	77	75	75	75	76
Tensile strength 1,000 pounds per square inch...	87	86	86	86	87	85

<sup>1</sup> Average of 3 replications each on early-, mid-, and late-season cottons.

<sup>2</sup> As determined by Shirley Analyzer tests.

<sup>3</sup> Average of 2 classifications on each replication.

<sup>4</sup> Based on 1,500 pounds of seed cotton.

cleaner in lieu of a standard moting system. There was, however, a one-third grade improvement in favor of lint cleaning. Staple length was unaffected by the different moting systems. This was substantiated by fibrograph tests that showed no significant difference in upper half mean and uniformity for the various systems as compared with the control lot. Tensile strength was also unaffected.

The standard gin moting system removed an average of 2.2 pounds of foreign matter per bale as compared with an average of 5.2 pounds for the 3-bar reciprocleaner and 6.1 pounds for the 2-bar unit. Of the total amount of foreign material removed by the various gin moting systems, that removed by the standard gin contained 0.6 pound of leaf trash per bale as compared with 1.4 and 1.5 pounds for the 3- and 2-bar reciprocleaner units, respectively. The increased amount of foreign matter removed by the 2-bar unit was reflected in a slight increase in grade index, when compared with the results obtained with the 3-bar unit. This small grade increase was also borne out by Shirley Analyzer tests on the lint.

Three replicate lots of midseason hand-picked cotton were selected for spinning tests. The seed cotton was quite clean and dry, averaging only 6.4 percent in moisture content and 3.6 percent in foreign-matter content (table 6). As a result, neither the lint cleaner nor the reciprocleaner showed consistent grade benefits. Results from spinning tests gave no indication of the yarn strength or yarn appearance being affected by the experimental devices. There was, however, a consistent reduction in manufacturing waste in favor of the reciprocleaner units over the standard gin. Specifically, the 3-bar unit reduced the manufacturing waste almost 7 percent, and the 2-bar model reduced the manufacturing waste 2 percent more than the moting system of a standard gin.

The tests on machine-picked cotton showed an average of one-third grade improvement in favor of lint cleaning and a slightly smaller grade improvement in favor of the reciprocleaner units over the standard gin. The moting system of the standard gin removed an average of 5.4 pounds of foreign material per bale as compared with 7.9 and 11.0 pounds for the 3- and 2-bar reciprocleaner units, respectively (table 7). The lint cleaner removed less total waste when operated in conjunction with the reciprocleaner units than when operated with a standard gin, because the reciprocleaner removed some material that would otherwise have been taken out by the lint cleaner. Shirley Analyzer tests showed that the 3-bar reciprocleaner removed 8.2 percent more material than the moting system of the standard gin, and the 2-bar unit removed 16.4 percent more. An analysis of the foreign matter removed by the moting systems showed that the 2-bar unit removed substantially more leaf trash from the lint than either the standard gin or the 3-bar unit. The lint cleaner removed about 8.0 percent more than the moting system of the standard gin.

Three replicate lots of late-season machine-picked cotton were selected for spinning tests. As with hand-picked cotton, neither the reciprocleaner units nor the lint cleaner, when used separately or in combination, had adverse effects on the spinning quality of the lint (table 8). Manufacturing waste was reduced from 10.3 pounds per 100 pounds of lint with the standard gin to 9.6 and 8.7 pounds with the 3- and 2-bar reciprocleaners, respectively. This is a reduction of

6.8 percent for the 3-bar, and 15.5 percent for the 2-bar units over that obtained with the standard gin. The use of the lint cleaner in combination with these units reduced the manufacturing waste still further.

TABLE 6.—*Moisture and foreign-matter content of hand-picked cotton prior to ginning and the comparative effects of a standard gin and 3- and 2-bar reciproc-cleaner units, with and without lint cleaners, on lint moisture, foreign-matter content and removal, classification, fiber, and spinning quality elements*<sup>1</sup>

Item	Standard gin		Reciproc-cleaner <sup>2</sup>			
			3-bar unit		2-bar unit	
	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing
Moisture content:						
Wagon sample...percent...	6.4	6.4	6.4	6.4	6.4	6.4
Lint sample...do...	4.3	4.2	4.3	4.3	4.0	4.2
Foreign-matter content:						
Wagon sample...do...	3.6	3.6	3.6	3.6	3.6	3.6
Lint sample...do...	3.6	3.1	3.6	3.5	3.5	3.4
Classification data: <sup>2</sup>						
Grade index.....	101.0	103.0	101.0	101.7	101.0	101.0
Grade designation.....	M+	SM-	M+	M+	M+	M+
Staple length... $\frac{1}{32}$ -inch...	34.0	34.0	33.7	34.0	33.7	33.7
Foreign matter removed per bale: <sup>3</sup>						
Moting system...pounds...	2.6	2.6	5.4	5.4	8.9	8.9
Lint cleaner...do...		5.3		5.5		4.4
Fiber data:						
Upper half mean length inches...	1.03	1.04	1.03	1.03	1.02	1.02
Uniformity ratio.....	75	76	74	73	74	74
Tensile strength 1,000 pounds per square inch...	83	83	84	83	84	84
Spinning data: <sup>4</sup>						
Picker and card waste percent...	8.8	8.3	8.2	7.8	8.6	7.8
Neps per 100 square inches of card web...number...	28	37	30	32	25	33
Yarn skein strength—						
22s.....pounds...	113	109	111	111	113	109
50s.....do...	38	38	38	38	39	38
Yarn appearance—						
22s.....index...	110	100	100	100	110	100
50s.....do...	80	80	80	80	80	80

<sup>1</sup> Average of 3 replications on midseason cotton.

<sup>2</sup> Average of 2 classifications on each replication.

<sup>3</sup> Based on 1,500 pounds of seed cotton.

<sup>4</sup> Replicate lots processed separately through the card and combined for spinning.



These laboratory tests and tests on a commercial gin in the field proved the reciprocleaner to be a practical and efficient moting system for gins. From an operational standpoint, the 2-bar unit gave more satisfactory performance. There was less tendency for it to choke, and it required less maintenance than the 3-bar model. From a quality standpoint, on both hand- and machine-picked cottons, the 2-bar unit removed more material from the lint and gave a correspondingly higher grade than the 3-bar unit. Shirley Analyzer tests confirmed the fact that the 2-bar model removed more foreign matter from the lint than the 3-bar unit, and this is further substantiated by an analysis of the foreign matter removed by the moting systems and corresponding reductions in manufacturing waste. The recipro-

TABLE 7.—*Moisture and foreign-matter content of machine-picked cotton prior to ginning and the comparative effects of a standard gin and 3- and 2-bar reciprocleaner units, with and without lint cleaners, on lint moisture, foreign-matter content and removal, classification, and fiber quality elements*<sup>1</sup>

Item	Standard gin		Reciprocleaner			
			3-bar unit		2-bar unit	
	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing
Moisture content:						
Wagon sample...percent...	9.6	9.6	9.6	9.6	9.6	9.6
Lint sample...do.....	5.6	5.6	5.5	5.3	5.4	5.2
Foreign-matter content:						
Wagon sample...do.....	6.0	6.0	6.0	6.0	6.0	6.0
Lint sample...do.....	6.1	5.0	5.6	4.8	5.1	4.3
Classification data: <sup>2</sup>						
Grade index.....	93.4	95.7	93.9	95.9	94.3	95.9
Grade designation.....	SLM	SLM+	SLM	SLM+	SLM	SLM+
Staple length... $\frac{1}{32}$ -inch...	34.4	34.3	34.3	34.4	34.3	34.4
Foreign matter removed per bale: <sup>3</sup>						
Moting system—						
Motes...pounds...	2.3	2.3	3.4	3.4	4.7	4.7
Leaf trash...do.....	2.5	2.5	3.6	3.6	4.5	4.5
Lint...do.....	.6	.6	.9	.9	1.8	1.8
Total...do.....	5.4	5.4	7.9	7.9	11.0	11.0
Lint cleaner...do.....	-----	7.8	-----	7.7	-----	6.8
Fiber data:						
Upper half mean length inches...	1.06	1.07	1.06	1.06	1.05	1.05
Uniformity ratio.....	74	75	75	75	75	75
Tensile strength...1,000 pounds per square inch...	85	84	84	84	85	83

<sup>1</sup> Average of 3 replications each on early-, mid-, and late-season cottons.

<sup>2</sup> Average of 2 classifications on each replication.

<sup>3</sup> Based on 1,500 pounds of seed cotton.

cleaner does not affect the operation of a lint cleaner and is about one-half as effective as a lint cleaner when using a 1945 model gin stand as a control.

While progress was being made at the Laboratory on the reciproc-cleaner, gin manufacturers were improving the effectiveness of the

TABLE 8.—*Moisture and foreign-matter content of machine-picked cotton prior to ginning, and the comparative effects of a standard gin and 3- and 2-bar reciproc-cleaner units, with and without lint cleaners, on lint moisture, foreign-matter content and removal, classification, and fiber and spinning quality elements*<sup>1</sup>

Item	Standard gin		Reciproc-cleaner			
			3-bar unit		2-bar unit	
	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing	With- out lint clean- ing	With lint clean- ing
Moisture content:						
Wagon sample...percent..	7.5	7.5	7.5	7.5	7.5	7.5
Lint sample...do.....	4.8	4.9	4.7	4.6	4.8	4.5
Foreign-matter content:						
Wagon sample...percent..	7.6	7.6	7.6	7.6	7.6	7.6
Lint sample...do.....	5.7	4.5	5.2	4.3	4.4	3.7
Classification data: <sup>2</sup>						
Grade index.....	94.7	97.8	95.0	97.7	96.0	99.3
Grade designation.....	SLM	M—	SLM	M—	SLM+	M
Staple length... $\frac{1}{32}$ -inch..	34.3	34.2	34.2	34.2	34.3	34.5
Foreign matter removed per bale: <sup>3</sup>						
Moting system...pounds..	4.5	4.5	6.5	6.5	7.9	7.9
Lint cleaner...do.....		8.6		8.4		7.4
Fiber data:						
Upper half mean length inches.....	1.08	1.08	1.08	1.07	1.07	1.07
Uniformity ratio.....	76	75	75	75	74	76
Tensile strength...1,000 pounds per square inch..	84	84	85	83	84	83
Spinning data: <sup>4</sup>						
Picker and card waste percent.....	10.3	8.7	9.6	8.8	8.7	8.1
Neps per 100 square inch of card web...number..	11	13	8	13	11	11
Yarn skein strength—						
22s.....pounds.....	113	112	115	111	112	111
50s.....do.....	39	39	39	39	39	38
Yarn appearance—						
22s.....index.....	120	110	120	110	110	120
50s.....do.....	110	90	100	100	100	90

<sup>1</sup> Average of 3 replications of late-season cottons.

<sup>2</sup> Average of 2 classifications on each replication.

<sup>3</sup> Based on 1,500 pounds of seed cotton.

<sup>4</sup> Replicate lots processed separately through the card and combined for spinning.

moting systems used in their gins, and as a result late-model gin stands are generally superior in moting action to the stands that were being sold before 1949.

Recognizing the improvements that had been made, laboratory tests were planned for the 1953-54 season to ascertain how well the reciprocleaner compared with late-model gins. Early-, mid-, and late-season hand- and machine-picked cottons were used for the tests. The hand-picked cotton averaged 6.5 percent in moisture content and 1.2 percent in foreign-matter content (table 9). The reciprocleaner gave a higher grade index than the commercial gins. The grade improvement was borne out by Shirley Analyzer tests, which showed that the lint from the reciprocleaner contained 2.9 percent foreign matter as compared to an average of 3.3 percent for the commercial gins. The reciprocleaner removed a total of 5.7 pounds of foreign material per bale as compared to 4.4 pounds by the conventional system. There were virtually no differences in staple length or in fiber properties.

TABLE 9.—*Results of tests between a 1945 model 2-bar reciprocleaner gin stand and 3 1953 model commercial gin stands on hand-picked cotton on moisture and foreign-matter content prior to ginning, lint moisture, foreign-matter content and removal, classification, and fiber quality elements, 1953 crop*<sup>1</sup>

Item	Moting system	
	2-bar reciprocleaner	Commercial gins (average)
Moisture content:		
Wagon.....percent	6.5	6.5
Feeder.....do	6.3	6.1
Lint.....do	5.3	5.2
Foreign-matter content:		
Wagon.....do	1.2	1.2
Feeder.....do	.7	.8
Lint sample.....do	2.9	3.3
Classification: <sup>2</sup>		
Grade index.....	101.4	100.5
Grade designation.....	M+	M+
Staple length..... $\frac{1}{32}$ -inch	34.1	34.0
Foreign matter removed per bale: <sup>3</sup>		
Notes.....pounds	2.4	1.6
Leaf trash.....do	2.0	1.8
Lint.....do	1.3	1.0
Total.....do	5.7	4.4
Fiber data:		
Upper half mean length.....inches	1.09	1.08
Uniformity ratio.....	75	74
Tensile strength.....1,000 pounds per square inch	77	78
Neps per 100 square inches of card web.....number	14	14

<sup>1</sup> Average of 3 replications each on early, mid-, and late-season cottons.

<sup>2</sup> Average of 2 classifications on each replication.

<sup>3</sup> Based on 1,300 pounds seed cotton.

In the machine-picked series of tests, the cotton classifier found a very slight difference in grade in favor of the reciprocleaner as compared with the commercial systems (table 10). Likewise, Shirley Analyzer tests showed a slight difference in the foreign-matter content of the lint in favor of the reciprocleaner. The reciprocleaner removed an average of 12.4 pounds of material per bale as compared with an average of 9.1 pounds per bale for the conventional systems. As in the case with the hand-picked cottons, there was no significant difference in staple length or in fiber quality.

These tests, based on 1 year's data, show that the reciprocleaner is an effective moting device, and it appears to be slightly superior on the average than present modern moting systems. It is much more effective than old-type moting methods.

TABLE 10.—*Results of tests between a 1949 model 2-bar reciprocleaner gin stand and 3 1953 model commercial gin stands on machine-picked cotton on moisture and foreign-matter content prior to ginning, lint moisture, foreign-matter content and removal, classification, and fiber quality elements, 1953 crop*<sup>1</sup>

Item	Moting system	
	2-bar reciprocleaner	Commercial gins (average)
Moisture content:		
Wagon.....percent	10. 0	10. 0
Feeder.....do	7. 3	7. 3
Lint.....do	5. 4	5. 3
Foreign-matter content:		
Wagon.....do	6. 4	6. 4
Feeder.....do	1. 6	1. 8
Lint sample.....do	4. 5	4. 7
Classification: <sup>2</sup>		
Grade index.....	97. 0	96. 1
Grade designation.....	SLM+	SLM+
Staple length..... $\frac{1}{32}$ -inch	34. 0	34. 0
Foreign matter removed per bale: <sup>3</sup>		
Motes.....pounds	4. 3	2. 5
Leaf trash.....do	6. 2	5. 1
Lint.....do	1. 9	1. 5
Total.....do	12. 4	9. 1
Fiber data:		
Upper half mean length.....inches	1. 07	1. 07
Uniformity ratio.....	75	74
Tensile strength.....1,000 pounds per square inch	78	78
Neps per 100 square inches of card web.....number	26	25

<sup>1</sup> Average of 3 replications on early-, mid-, and late-season cottons.

<sup>2</sup> Average of 2 classifications on each replication.

<sup>3</sup> Based on 1,500 pounds of seed cotton.



## PROBABLE USE OF THE RECIPROCLEANER IN OLD AND NEW PLANTS

Public Patent No. 2,634,461 has been obtained by the Department of Agriculture on the reciprocleaner, which clears the way for the free and full use by the trade of the device in whole or in part. As of 1954, 2 sets of 4 units each have been built to special order and satisfactorily operated in existing commercial gins. These cost approximately \$500 per gin stand. Detailed plans are available from which these USDA moting devices can be constructed to fit existing low-nozzle air-blast gins of the overhead moting type. Complete working drawings to fit the reciprocleaner into existing gravity moting, double moting, and brush gins have not as yet been made.

Space must be provided at the rear of the ginning ribs, not only for locating the reciprocating grids but for installing the ducts leading to the vacuum-wheel dropper. There are ample spaces for installing reciprocleaner units in existing low-nozzle overhead moting gins, and it was in this type of gin that the unit was first installed and successfully tested. It is apparent that the reciprocleaner can be more easily installed without major changes in a gin of this type, and therein lies probably the largest potential for its application. Estimates of the cost of such installation vary to some extent, but the indications are that the cost should not exceed \$500 to \$700 per stand at 1954 prices.

Consideration has been given to the possibility of designing a gin stand frame-and-nozzle assembly to work with the reciprocleaner units. This idea may include a welded-frame assembly to which the gin saw cylinder, gin ribs, huller ribs, and roll boxes of existing gins could be fitted. In this manner it should be possible to fit the unit to practically all of the existing saw gins in the United States. The cost of such an assembly would be greater than the cost of the moting device as fitted to a low-nozzle gin, but the purchase of one of these assemblies should still result in a saving over the purchase of a complete new gin stand. The reciprocleaner moting device requires less than 2 horsepower additional power per 4-stand gin.

Grades obtained from early to midseason hand-picked cottons ginned following a simple combination of gin cleaning machinery on stands equipped with these moting devices usually fall in the Middling grade range. Premiums paid for cottons grading above Middling often fail to equal losses associated with bale weight reductions from lint cleaning that would be required to raise them above the Middling range. It would appear from the foregoing analysis that the addition of the superior moting device could prove of great value to small-volume gins handling principally hand-picked cottons.

The possible use of this moting system in new gins will depend on the attitude of the gin-machinery manufacturers and their patrons. Most of the new model gin stands now being offered for sale have been greatly improved during the past few years and have one or more of the desirable features contained in the reciprocleaner unit. The designs being followed by the gin-machinery manufacturers were developed to fit into a pattern followed by each of the particular companies over a period of years. Such trends are rather inflexible, because they are greatly influenced by manufacturing facilities. The

reciprocleaner units require somewhat greater precision methods in manufacturing than are employed in conventional systems, to insure the close tolerances needed to obtain maximum effectiveness in trash removal.

The final acceptance of the reciprocleaner by the ginner will also depend largely on the showing made by the gins that are using the device. The improved moting devices installed in commercial gins are giving good results, and the record made by these gins in producing quality cotton will attract attention. Other installations made by ginner in existing gins will also influence the action taken by the gin-machinery manufacturers in making the units or adaptations of them available in new gin stands.

## SUMMARY

The trash and mote removal in early model gins was accomplished by action of natural forces on the fibers and was commonly referred to as moting. Several basic forces such as centrifugal force, velocity, and gravity, acting in combination on the cotton and foreign matter after doffing, caused various materials to separate from the lint. The effectiveness of the so-called gravity moting system in the brush gin and later in the air-blast gin was limited by the extent to which these several forces could be practically applied to the freshly ginned material while it was passing through the restricted space behind the ribs within the gin stand.

Several designs and modifications were tested before the reciprocleaner was deemed to be successful, although the basic design of using grid bars to scutch and smooth the fibers while they are being held by the saw teeth remained unchanged. The device was then redesigned and the bars made self-cleaning by a reciprocating motion, and the trailing edges of the trash ducts were sealed with a vacuum roller to prevent the siphoning action. Tests showed the reciprocleaner removed an average of 11.7 pounds of material per bale with the vacuum roller in place and 9.9 pounds without it. The serrated bars were replaced by smooth bars to prevent tags of lint from hanging on the bars. A series of tests carried out on machine-picked cotton in 3 replications showed that the reciprocleaner was almost as effective as a lint cleaner from a grade-improvement standpoint. Fiber and spinning tests showed the spinning quality of the cotton was not adversely affected by the reciprocleaner.

The reciprocleaner is an integral part of the gin stand and cannot be bypassed, as is the case with the lint cleaner. Therefore, tests were made using the 2-bar reciprocleaner, with and without a lint cleaner, on both hand- and machine-picked cottons that were representative of an entire season. The hand-picked cottons showed a slight grade improvement, and the machine-picked cottons showed about one-third of a grade improvement in favor of the reciprocleaner over a standard 1945 model gin stand. Spinning tests showed that the reciprocleaner reduced the manufacturing waste and did not have any adverse effect on the fiber and spinning quality of the cotton when used separately or in combination with lint cleaners.

Recognizing that a number of improvements had been made in recent years by gin manufacturers on the moting system used in their

respective gins, laboratory personnel made tests to determine the effectiveness of the reciprocleaner in comparison with these late-model stands. These tests, made in 3 replications on early-, mid-, and late-season hand- and machine-picked cotton, showed that the reciprocleaner compared favorably with the modern moting systems, and on the average the cottons from the reciprocleaner appeared to be slightly better from the standpoint of foreign matter removal.

A public patent has been obtained by the Department of Agriculture on the reciprocleaner, and it may be freely used as a whole or in part by the ginning industry. Units built on special order by gin manufacturers at a cost of about \$500 per gin stand are operating satisfactorily in commercial plants. Detailed plans are available only for the construction of these units for low-nozzle air-blast gins of the overhead moting type. Drawings are not available for gravity moting, double moting, or brush gins at this time. Owing to the limited space at the rear of the ginning ribs, it will be difficult to adapt the reciprocleaner to these various types of stands and some major changes in the gin stand may be necessary to accommodate the unit. About 2 horsepower is required to operate the reciprocleaner in a 4-stand gin.







